UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/707,047	11/18/2003	Tien-Jen Cheng	FIS920030278US1	1046

29371 7590 02/27/2006

CANTOR COLBURN LLP - IBM FISHKILL
55 GRIFFIN ROAD SOUTH
BLOOMFIELD, CT 06002

EXAMINER	
VAN, LUAN V	

ART UNIT	PAPER NUMBER
1753	

DATE MAILED: 02/27/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/707,047	CHENG ET AL.	
	Examiner	Art Unit	
	Luan V. Van	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *04 January 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-7* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

Applicant's amendment of January 4, 2006 does not render the application allowable.

The amendment filed January 4, 2006 is objected to under 35 U.S.C. 132(a) because it introduces new matter into the disclosure. 35 U.S.C. 132(a) states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: the claims 1-7 are amended to recite the limitation of "wherein said electroplating is implemented in the absence of a photolithographically formed masking layer." However, there is no evidence in the applicant's disclosure to support this limitation. The disclosure teaches that in the instant invention "there is no photoresist present during the actual electroplating step" (paragraph 15). The currently amended limitation is broader in scope than the disclosure, since an electroplating step that is implemented in the absence of a mask can be interpreted to mean that the mask can be present just prior to electroplating, while the disclosure only supports the absence of the mask during the actual electroplating. In addition, photolithographically formed masking layer can be comprised of materials other than photoresist. The disclosure, therefore, does not provide a clear indication to support the currently amended limitation. Applicant is required to cancel the new matter in the reply to this Office Action.

Status of Objections and Rejections

All rejections from the previous office action are withdrawn in view of the amendment.

New rejections under 35 U.S.C. 103(a) are necessitated by the amendments.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-7 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. the claims 1-7 are amended to recite the limitation of "wherein said electroplating is implemented in the absence of a photolithographically formed masking layer." However, there is no evidence in the applicant's disclosure to support this limitation. The disclosure teaches that in the instant invention "there is no photoresist present during the actual electroplating step" (paragraph 15). The currently amended limitation is broader in scope than the disclosure, since an electroplating step that is implemented in the absence of a mask can be interpreted to mean that the mask

can be present just prior to electroplating, while the disclosure only supports the absence of the mask during the actual electroplating. In addition, photolithographically formed masking layer can be comprised of materials other than photoresist. The disclosure, therefore, does not provide a clear indication to support the currently amended limitation.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 1, 2, 4, 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nye et al. in view of Chung et al.

Regarding claims 1 and 6, Nye et al. teach a method for selective electroplating an interconnection pad, the method comprising: forming a titanium-tungsten (TiW) layer

(column 6 lines 47-55) over a passivation layer on a semiconductor substrate, said TiW layer further extending into an opening formed in said passivation layer for exposing the interconnection pad, such that said TiW layer covers sidewalls of said opening and a top surface of the pad; forming a seed layer (column 6 lines 47-55) over said TiW layer, selectively removing portions of said seed layer (column 7 lines 35-37) such that remaining seed layer material corresponds to a desired location of interconnect metallurgy for the interconnection pad; and electroplating at least one metal layer over said remaining seed layer material (column 7 lines 55-67), using said TiW layer as a conductive electroplating medium. Further, Nye et al. teach the copper seed layer is patterned by depositing a blanket layer and subtractively etching it using a resist mask (column 7 lines 35-37). The solder is then selectively electroplated on the remaining seed layer in the subsequent step.

Nye et al. differs from the instant claims in that the reference does not explicitly teach electroplating a metal without a photoresist mask.

However, it is well known in the art to selectively electroplate a metal without a photoresist mask. For example, Chung et al. teach a method of selectively inhibiting the deposition of a conductive material within desired regions of a semiconductor device. A seed layer is rendered ineffective to the electroplating in select regions of the substrate by the removal of the seed layer in select regions (figure 4-5). A barrier layer 22, which may be comprised of tantalum, tantalum nitride, tungsten, titanium, titanium nitride, etc., provides a conductive path for electroplating a metal onto the seed layer within the trenches and vias of the substrate. Since the seed layer 24 is only present within the

trenches and vias of the substrate, metal is electrodeposited only in the trenches and vias of the substrate. Furthermore, Chung et al. teach conductive materials and seed layers other than copper, such as aluminum, silver, tin, lead, etc., or nickel, chromium, cobalt, etc., may also be used (column 5 lines 25-33); Chung et al. teach the invention may be used in conjunction structures having various circuit features, and is in no way intended to be limited to use with dual damascene structures (column 5 lines 25-33).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Nye et al. by electroplating a selected area without a photoresist mask as taught by Chung et al., because a skilled artistan would have recognized that metal is electrodeposited only onto the seed layer when using a titanium nitride barrier layer, thus electroplating a selected area without a photoresist mask as taught by Chung et al. would be a suitable alternative method for selective plating. Since Nye et al. disclose that a layer of titanium nitride can be used as an alternative to titanium tungsten layer (column 6 lines 59-65), a skilled artistan would have seek the teaching of Chung et al. for electroplating on a titanium nitride barrier layer.

Regarding claim 2, Nye et al. teach the seed layer further comprises a Cu/CrCu layer (column 6 lines 47-55).

Regarding claim 4, Nye et al. teach removing portions of said TiW layer not covered by said at least one metal layer following electroplating thereof (column 8 lines 24-27).

Regarding claim 7, Nye et al. teach the passivation layer further comprises a photosensitive polyimide (PSPI) layer (column 7 lines 7-11).

Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nye et al. in view of Chung et al., and further in view of Love et al.

Nye et al. and Chung et al. teach the method as described above in addressing claim 1. Nye et al. also teach that nickel can be used in addition to copper (column 10 lines 15-18) for bonding the CrCu layer and the gold layer (column 4 lines 35-38). The difference between the reference to Nye et al. and the instant claims is that the reference does not explicitly teach electroplating a nickel or the gold layer.

It is well known in the art that nickel and gold can be electroplated, and that the nickel and gold layer are deposited between the copper and the solder material. Love et al., for example, teach that the nickel layer acts as a barrier to any solder-copper chemical interactions (column 9 lines 33-25), and that gold is plated on the nickel layer to protect it from environmental corrosion and attack, since the nickel layer is susceptible to oxidation (column 24 lines 66-column 25 line 2).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Nye et al. and Chung et al. by electroplating the nickel layer followed by the gold layer as taught by Love et al., because plating the nickel layer prevents any solder-copper chemical interactions and

plating the gold layer on the nickel layer protects it from environmental corrosion and attack.

Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nye et al. in view of Chung et al., and further in view of Srivastava et al.

Nye et al. and Chung et al. teach the method as described above in addressing claim 1. Nye et al. also teach using an electrically conductive layer 60 (figure 3) to form the interconnection pad. The difference between the reference to Nye et al. and the instant claims is that the reference does not explicitly teach the interconnection pad comprises of aluminum.

Srivastava et al. teach that the interconnection pad can be composed of copper or aluminum metal pad or line (column 2 lines 36-39).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Nye et al. and Chung et al. by using the aluminum pad of Srivastava et al., because aluminum is a good electrical conductor and is well suited for forming the interconnection pad.

Response to Arguments

Applicant's arguments filed January 4, 2006 have been fully considered but they are not persuasive.

In the arguments presented on pages 7-8 of the amendment, the Applicant suggests that the references do not disclose every limitation of the amended claims. The examiner agrees, and thus the rejections under 35 U.S.C. 102(b) have been withdrawn. New rejections under 35 U.S.C. 103(a) are therefore appropriate. Chung et al. is relied upon to show a suitable alternate method for selective deposition of a conductive material without using photoresist.

As stated in the office action above, Nye et al. teach a method for selective electroplating an interconnection pad, the method comprising: forming a titanium-tungsten (TiW) layer (column 6 lines 47-55) over a passivation layer on a semiconductor substrate, said TiW layer further extending into an opening formed in said passivation layer for exposing the interconnection pad, such that said TiW layer covers sidewalls of said opening and a top surface of the pad; forming a seed layer (column 6 lines 47-55) over said TiW layer, selectively removing portions of said seed layer (column 7 lines 35-37) such that remaining seed layer material corresponds to a desired location of interconnect metallurgy for the interconnection pad; and electroplating at least one metal layer over said remaining seed layer material (column 7 lines 55-67), using said TiW layer as a conductive electroplating medium. Further, Nye et al. teach the copper seed layer is patterned by depositing a blanket layer and subtractively etching it using a resist mask (column 7 lines 35-37). The solder is then selectively electroplated on the remaining seed layer in the subsequent step.

Nye et al. differs from the instant claims in that the reference does not explicitly teach electroplating a metal without a photoresist mask.

However, it is well known in the art to selectively electroplate a metal without a photoresist mask. For example, Chung et al. teach a method of selectively inhibiting the deposition of a conductive material within desired regions of a semiconductor device. A seed layer is rendered ineffective to the electroplating in select regions of the substrate by the removal of the seed layer in select regions (figure 4-5). A barrier layer 22, which may be comprised of tantalum, tantalum nitride, tungsten, titanium, titanium nitride, etc., provides a conductive path for electroplating a metal onto the seed layer within the trenches and vias of the substrate. Since the seed layer 24 is only present within the trenches and vias of the substrate, metal is electrodeposited only in the trenches and vias of the substrate. Furthermore, Chung et al. teach conductive materials and seed layers other than copper, such as aluminum, silver, tin, lead, etc., or nickel, chromium, cobalt, etc., may also be used (column 5 lines 25-33); Chung et al. teach the invention may be used in conjunction structures having various circuit features, and is in no way intended to be limited to use with dual damascene structures (column 5 lines 25-33).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Nye et al. by electroplating a selected area without a photoresist mask as taught by Chung et al., because a skilled artistan would have recognized that metal is electrodeposited only onto the seed layer when using a titanium nitride barrier layer, thus electroplating a selected area without a photoresist mask as taught by Chung et al. would be a suitable alternative method for

selective plating. Since Nye et al. disclose that a layer of titanium nitride can be used as an alternative to titanium tungsten layer (column 6 lines 59-65), a skilled artistan would have seek the teaching of Chung et al. for electroplating on a titanium nitride barrier layer.

Conclusion

The prior art made of record and not relied upon is considered pertinent to the applicant's disclosure. Uzoh et al. teach a similar method for selective deposition on a barrier layer without using photoresist.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Luan V. Van whose telephone number is 571-272-8521. The examiner can normally be reached on M-F 9:30-6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

LVV
2/21/2006

NAM NGUYEN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700